Marconi
Instruments

6912

RF POWER SENSOR

Instruction Manual

Instruction Manual

H 6912

RF POWER SENSOR
6912

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PRELIMINARIES

Title page
Contents
Notes and Cautions

CHAPTERS

1 General information
2 Installation
3 Operation
4 Technical description
5 Maintenance
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7 Servicing diagrams

The following symbols appear on the equipment.

Symbol	*Type of hazard*	*Reference in manual*
⚠	Dismantling sequence	Chap. 5, page 4
⚠	Precision type N connector	Page (iv)

Note...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am. 2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus ▶ ..... ◀ to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

ELECTRICAL SAFETY PRECAUTIONS

This accessory, when used with the 6950 or 6960 RF Power Meter, is protected in accordance with IEC Safety Class 1. It has been designed and tested according to IEC Publication 148 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition.

MEASUREMENT PRECAUTIONS

This sensor contains a sensitive detector. Because of this the r.f. connector must be properly terminated to prevent stray radiation being detected and displayed on the power meter. It is also important to allow thermal stability to be obtained before zeroing or operating the power meter.

CAUTION : STATIC SENSITIVE COMPONENTS

Components identified with the symbol ⚠ on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by orange discs, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disc or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

WARNING : HANDLING HAZARDS

Whilst every endeavour has been made to remove sharp points and edges care should be taken, particularly when servicing the equipment, to avoid minor cuts.

WARNING : TOXIC HAZARD

Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should therefore be taken in the disposal of these items.

⚠ *CAUTION :* PRECISION CONNECTOR

The precision type N connector fitted to this sensor may be damaged by mating with general purpose type N connectors.

Chapter 1

GENERAL INFORMATION

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1 Features
4 Performance data

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1 RF Power Sensor type 6912 1

FEATURES

1. The RF Power Sensor 6912 is for use with analog RF Power Meter type 6950 and microprocessor RF Power Meter type 6960 in measuring r.f. power from 30 kHz to 4.2 GHz over a 50 dB dynamic range from -30 dBm (1 µW) to +20 dBm (100 mW).

2. To enhance the power measuring accuracy, each sensor has an individual label giving the following data :

Reference calibration factor - to standardize the power meter reading at 50 MHz.

Calibration factor (graph) - to correct the reading at other frequencies.

Linearity factor - to provide power accuracy enhancement when used with 6960 Power Meter.

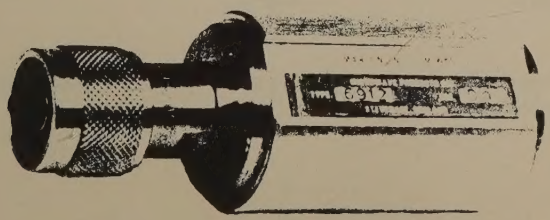

Fig. 1 RF Power Sensor type 6912

3. Each r.f. sensor provides high level signals to the power meter so that the possibility of r.f. susceptibility is virtually eliminated.

PERFORMANCE DATA

	Characteristic	*Performance*
4.	Power range :	-30 dBm (1 µW) to +20 dBm (100 mW).
	Maximum r.f. input :	+24.8 dBm (300 mW) average. Peak power 15 W for 2 µs.
	Frequency range :	30 kHz to 4.2 GHz.
	VSWR :	30 - 100 kHz : 1.6, 100 - 300 kHz : 1.2, 300 kHz - 4.2 GHz : 1.1.
	Linearity factor :	Provided with sensor.* Accuracy ±0.5% at 25°C.
	Calibration factor :	Provided with sensor.
	RF connector :	Precision N-type male, 50 Ω.
	Output connector :	Multiway. Mates with sensor cable assembly (supplied with power meter).
	Size :	87 mm long (including connectors), 33.5 mm dia.
	Weight :	140 g.

* Linearity factor is present in 6950 and selectable in 6960.

Chapter 2

INSTALLATION

UNPACKING AND REPACKING

1. Retain the packing materials and the packing instruction note (if included) in case it is necessary to reship the sensor.

2. If the sensor is to be returned for servicing attach a label indicating the service required, type number, serial number and your return address.

3. If the original container or materials are not available use a strong double-wall carton packed with shock absorbing material around all sides of the sensor to hold it firmly.

Chapter 3

OPERATION

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1 With Power Meter type 6950
6 With Power Meter type 6960

With Power Meter type 6950

1. Connect the power sensor to the SENSOR INPUT socket using the sensor cable assembly supplied with the instrument. With no power applied to the sensor adjust the ZERO control on the most sensitive range (RANGE switch fully anti-clockwise) for zero reading on the meter.* The rear panel RESPONSE-TIME potentiometer may be adjusted to reduce the noise, helping to set the zero. It may be easier to start on a less sensitive range as the ZERO adjustment has considerable effect.

2. Set the RANGE switch to 0 dBm. Connect the sensor to the POWER REFERENCE output on the 6950 Power Meter. Determine the 50 MHz REFERENCE CAL FACTOR from the calibration label on the sensor or the calibration certificate provided. Set the CAL FACTOR knob to this figure. Switch on the POWER REF on the rear panel and adjust the front panel GAIN control for a full-scale meter reading of 0 dBm.

3. Switch off the POWER REF and disconnect the sensor from the output.

* *CAUTION*

(1) Before setting up or making measurements allow time for thermal stabilization.

(2) An unterminated sensor could be affected by r.f. pick-up.

4. Determine the CAL FACTOR for the measurement frequency from the calibration curve on the power sensor or the calibration certificate provided. Set the CAL FACTOR knob accordingly.

5. The power meter can now be used for measuring r.f. power.* For full instructions and uncertainty calculations refer to the 6950 Operating Manual, Chap. 3.

With Power Meter type 6960

6. Connect the power sensor to the SENSOR INPUT socket using the sensor cable assembly supplied with the instrument. Determine the linearity factor of the sensor from the calibration label on the sensor or the calibration certificate provided. Enter this into the 6960 using the LINEARITY FACTOR function.

7. With no power applied to the sensor press AUTO ZERO.* Wait approximately 20 seconds for this routine to complete, after which a zero reading should be displayed.

8. Connect the sensor to the POWER REFERENCE output of the 6960 Power Meter. Determine the 50 MHz REFERENCE CAL FACTOR from the calibration label on the sensor or the calibration certificate provided. Enter this into the 6960 using the CAL FACTOR function. Press AUTO CAL. The instrument should now read 0 dBm with the POWER REF on.

9. Switch off the POWER REF and disconnect the sensor from the POWER REFERENCE output.

* *CAUTION*

(1) Before setting up or making measurement allow time for thermal stabilization.

(2) An unterminated sensor could be affected by r.f, pick-up.

10. Determine the CAL FACTOR for the measurement frequency from the calibration curve on the power sensor or the calibration certificate provided. Use the CAL FACTOR function to enter this on the 6960.

11. The power meter can now be used for measuring r.f. power.* For full instructions and uncertainty calculations refer to the 6960 Operating Manual, Chap. 3.

* *CAUTION*

(1) Before setting up or making measurement allow time for thermal stabilization.

(2) An unterminated sensor could be affected by r.f. pick-up.

Chapter 4

TECHNICAL DESCRIPTION

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1 Overall circuit description
2 Detailed technical description
2 RF sensor
3 Signal chopper
5 Amplifier

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2 Simplified diagram of amplifier 2

OVERALL CIRCUIT DESCRIPTION - see Fig. 1

1. The RF SENSOR gives a small d.c. output voltage when power is applied. This d.c. voltage is converted to an a.c. signal by the SIGNAL CHOPPER. The chopped signal is fed to the AMPLIFIER which is divided into two parts, the first part being the power sensor and the other in the power meter. The signal is then processed by the power meter to give a power reading. A Zener diode in the power sensor provides sensor type information for the power meter.

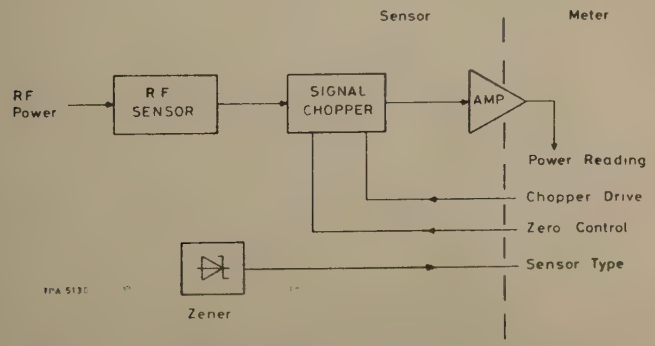

Fig. 1 Block diagram of r.f. power sensor

DETAILED DESCRIPTION *(Cct. diagram : Chap. 7, Fig. 1)*

RF sensor

2. The r.f. sensor consists of a monolithic semi-conductor thermocouple element. This element provides a good 50 Ω match to the r.f. power and an output voltage proportional to the r.f. power.

Signal chopper

3. The signal chopper consists of two field-effect transistors which act as a sampling gate. The sampling rate is controlled by a 925 Hz square wave signal from the power meter. The output of the signal chopper is a 925 Hz square wave with amplitude proportional to the r.f. input power.

4. A zero control signal from the power meter is introduced at the input of the signal chopper. This allows the power meter to cancel any residual output that occurs with no r.f. power applied.

Amplifier

5. The amplifier is divided between the power sensor and the power meter. A simplified circuit is shown in Fig. 2.

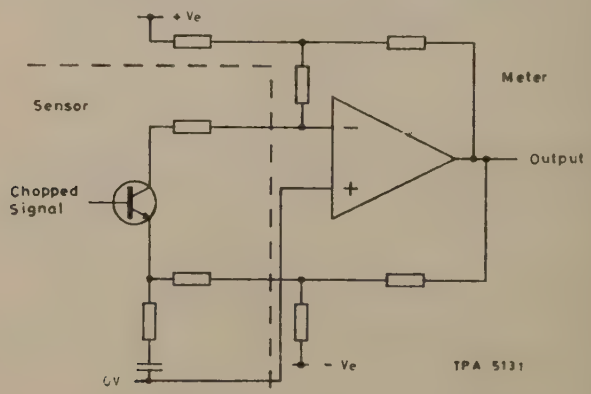

Fig. 2 Simplified diagram of amplifier

6. The amplifier has a gain of approximately 1000 and a band-pass characteristic centred at the sampling rate of 925 Hz. For a full description of the amplifier refer to the 6950 or 6960 Service Manuals.

7. A 6.8 V Zener diode is mounted in the sensor to provide head select information for the power meters.

Chapter 5

MAINTENANCE

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1 Test equipment
2 Precautions
3 Initial testing
4 Access
5 Fault finding
6 Testing the chopper assembly
7 Dismantling
12 Reassembly

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TEST EQUIPMENT

1.

Description	*Specification*
6950 or 6960 Power Meter (with sensor cable)	
Digital voltmeter	Resolution : 10 μV, : 1 Ω.
Power supply	Capable of producing ±5 V d.c.
10 kΩ resistor	
Oscilloscope	Bandwidth : >20 kHz. Sensitivity : Better than 50 mV/div.

PRECAUTIONS

2. To avoid possible damage to the sensor be very careful when measuring across or close to the gold wires of the r.f. assembly. They are of a delicate construction and can easily be damaged. All probes must be free of dirt and grease as these can impair the performance of the sensor, particularly in the vicinity of the gold wires and clamp assembly.

INITIAL TESTING

3. Connect the sensor to a known working power meter type 6960 or 6950 using a known working sensor cable. Try to zero and calibrate the sensor as described in Chap. 3. Should either fail proceed as follows.

ACCESS - see Fig. 1

4. Remove the sensor cable from the 12 pin connector on the sensor. Remove the rear plate screws (1) and (2). Remove the rear plate and slide the casing from the sensor.

FAULT FINDING

5. Reconnect the sensor cable and power meter. Connect the input to the 1 mW 50 MHz reference output of the power meter. Switch on the reference and carry out the following procedure.

(1) Carefully measure the voltage across the gold pads on the FET chopper assembly.

(2) If this is 100 µV or greater the r.f. assembly is functioning correctly. Test the chopper assembly as described in para. 6.

(3) If the voltage is less than 100 µV remove the sensor from the 1 mW reference. Remove the beam clamp after first loosening the clamp screw (3) and then removing the beam clamp fixing screws (4) and (5). Carefully lift the gold wires of the r.f. assembly clear of the gold pads.

(4) Reconnect the sensor to the 1 mW reference and carefully measure the voltage across the gold wires. If this is less than 100 µV the r.f. assembly is faulty and must be replaced.

TESTING THE CHOPPER ASSEMBLY

6. Disconnect the sensor from the 1 mW reference and remove the sensor cable. Remove the beam clamp as described in para. 5 (step 3). Connect together sockets B, G and H of the 12 pin connector to turn both chopper f.e.t's on then carry out the following procedure:-

(1) Measure the resistance between the two gold pads on the chopper assembly. This should be approximately 100 - 200 Ω.

(2) Connect the +ve output of a 5 V d.c. power supply to socket B.

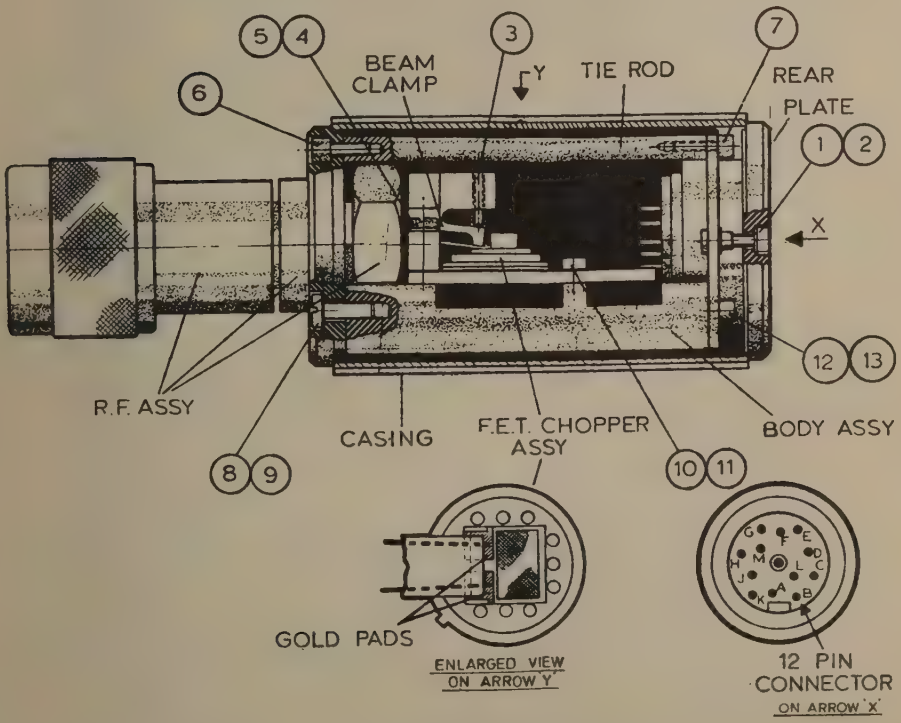

Fig. 1 Access and layout diagram

(3) Connect socket G to socket B and apply -5 V to socket H. This will turn off the parallel f.e.t. of the chopper. The resistance measured between the gold pads should now be greater than 10 kΩ.

(4) Connect socket H to socket B and apply -5 V to socket G. This will turn off the series f.e.t. of the chopper. The resistance measured across the gold pads should be greater than 10 kΩ.

⚠ Dismantling

7. To avoid damage to the internally connected gold wires dismantling must be carried out in the following order:-

Remove the rear plate screws (1) and (2).
Remove the rear plate and slide the casing off the sensor.

8. Loosen the clamp screw (3) then remove the beam clamp fixing screws (4) and (5). Carefully remove the beam clamp.

9. Remove the tie rod by undoing screws (6) and (7).

10. Carefully remove the r.f. assembly fixing screws (8) and (9). Separate the r.f. assembly from the body assembly without damaging the gold wires.

11. Remove the circuit board fixing screws (10) and (11).
Remove the body flange screws (12) and (13).
The circuit board and 12 pin connector are now free.

Reassembly

12. The circuit board and 12 pin connector are fixed to the body by replacing the body flange fixing screws (12) and (13) and the circuit board screws (10) and (11).

13. Carefully offer up the r.f. assembly to the body without damaging the gold wires. Fit the fixing screws (8) and (9).

14. Carefully line up the gold wires over the middle of the gold pads on the chopper assembly.

15. Ensure that the clamp screw (3) is not in contact with the lower part of the plastic clamp and fit the beam clamp in position using the fixing screws (4) and (5).

16. Tighten the clamp screw (3) to firmly clamp the gold wires - a torque of 2 cNm (2.8 oz in) is recommended.

17. Connect the partly assembled sensor to a power meter and check that it is functioning correctly as described in para. 3.

18. Fit the tie rod in position using screws (6) and (7).

19. Fit the casing and rear plate followed by the rear plate screws (1) and (2).

Chapter 6

REPLACEABLE PARTS

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1 Abbreviations
2 Component values
4 Ordering
5 Components

ABBREVIATIONS

1. The components are listed in alphanumerical order of the complete circuit reference using abbreviations from the following list :

C : capacitor
Carb : carbon
Cer : ceramic
D : semiconductor diode
Elec : electrolytic
FS : fuse
IC : integrated circuit (package)
L : inductor
LP : lamp
Max : maximum
ME : meter
Met : metal
Mic : mica
Min : minimum
Ox : oxide
Pl : plug
Plas : plastic
R : resistor
S : switch
SK : socket
T : transformer
Tant : tantalum

TP : terminal
TR : transistor
Var : variable
W : watts at 70°C
WW : wirewound
: value selected during test; nominal value listed
Ø : feedthrough component
: static sensitive component

COMPONENT VALUES

2. One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

(a) Components indicated by a † have their values selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

3. When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

ORDERING

4. When ordering replacements, address the order to the Technical Services Department of our Microwave Products Division (address on rear cover) or nearest agent and specify the following for each component required :

(1) Type and serial number of equipment.
(2) Circuit reference.
(3) Description.
(4) Part number.

COMPONENTS

Circuit ref.	*Description*	*Manufacturer/ Part No.*
	Power sensor, complete assy.	6912-001
	N type r.f. assy. replacement kit	6912-008
	Body assy. (includes Amplifier p.c.b. and Connector assy. SK1)	6912-002
	Connector assy, SK1	6912-052
	Amplifier p.c.b. assy.	6912-003
C1	Cer 0.01µF 20% 100V	ITT B111 MZ5U
C2	Tant 4.7µF 20% 50V	STC 39479A
C3	Tant 4.7µF 20% 6.3V	SPRAGUE 499D
C4	Tant 1µF 20% 35V	26486-209F
C5	Chip 100pF 10% 100V	STC 0805 FX7R
C6	Chip 100pF 10% 100V	STC 0805 FX7R
C7	Tant 2.2µF 20% 50V	STC 42310X
D1	Zener BZX796V8	28371-550W
R1	RES MF 348k 0.5% 1/8W	HOLCO H8
R2	RES MO 330 2% 1/8W	CORNING NK3
R3	RES MO 2.2k 2% 1/8W	CORNING NK3
R4	RES MO 10k 2% 1/8W	CORNING NK3
R5	RES WW 100 2% 1/8W	6910-043
	FET Chopper assy.	6910-004
TR1	TRANS BC414	Motorola

Mechanical parts

	Beam clamp	6910-048
	Fixing screws (2 off)	21821-211W
	Centre fixing screw (1 off)	21815-359X
	Casing	6910-018
	Rear plate	6910-019
	Tie rod	6910-028

Chapter 7

CIRCUIT DIAGRAM

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1 Component values

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Component values

1. The letter in the component value code replaces the decimal point and indicates the multiplier and unit as follows:-

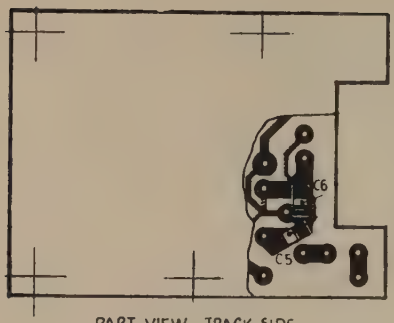
Resistors : Code letter R = ohms, k = kilohms (10^3),
M = megohms (10^6).

Capacitors : Code letter m = millifarads (10^{-3}),
μ = microfarads (10^{-6}),
n = nanofarads (10^{-9}),
p = picofarads (10^{-12}).

Inductors : Code letter H = henrys, m = millihenrys (10^{-3}),
μ = microhenrys (10^{-6}),
n = nanohenrys (10^{-9}).

* SIC : value selected during test, nominal value shown.

2. Components are marked normally with two, three or four figures according to the accuracy limit ±10%, ±1% or ±0.1%. Because a value 4m7 could be interpreted as 4.7 milliohms, millifarads or millihenrys, each value on circuit diagrams is placed near to its related symbol.



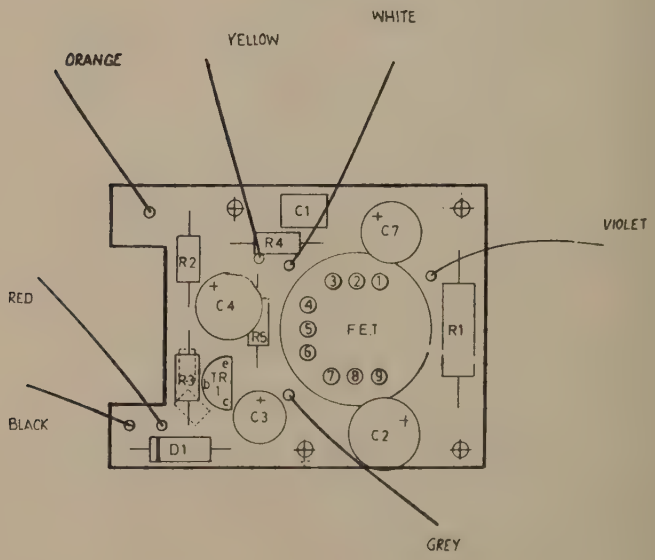
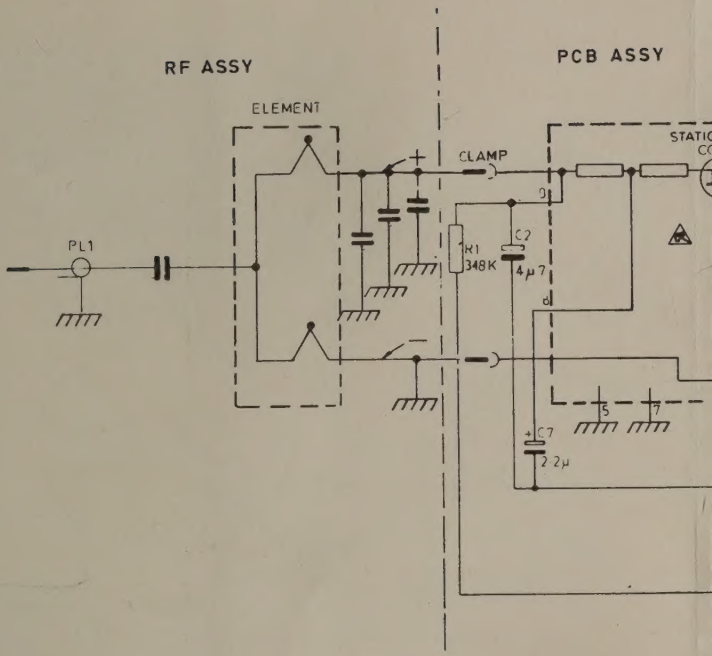


Fig. 1a Amplifier p.c.b. layout



FET CHOPPER
PIN LAYOUT

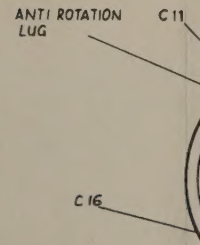
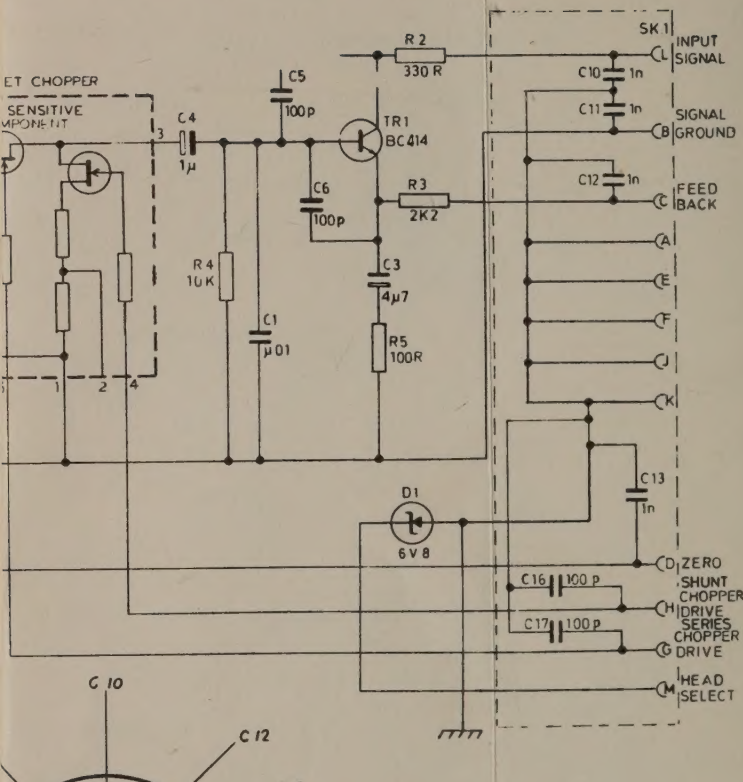
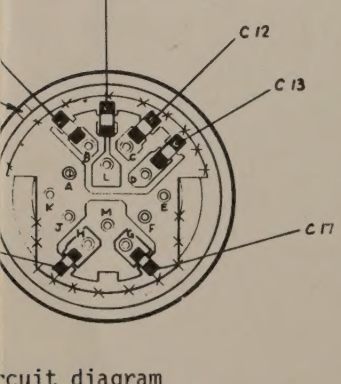


Fig. 1 Ci





CONNECTOR ASSY

rcuit diagram

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